

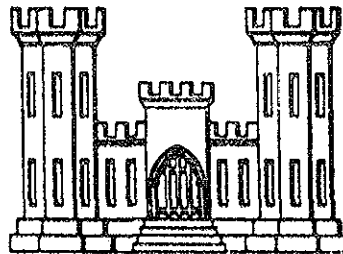
HOUSATONIC RIVER FLOOD CONTROL

WATERBURY & WATERTOWN

LOCAL PROTECTION

NAUGATUCK RIVER, CONNECTICUT

GENERAL DESIGN MEMORANDUM



U.S. Army Engineer Division, New England

Corps of Engineers

Boston, Mass.

January 1958

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

150 CAUSEWAY STREET
BOSTON 14, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

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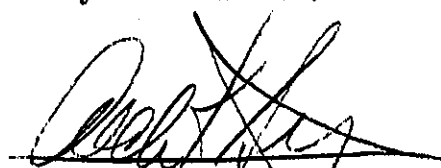
13 January 1958

SUBJECT: Submission of Design Memorandum for Local Protection Project, Naugatuck River, Housatonic River Basin, Waterbury and Watertown, Connecticut

TO: Chief of Engineers
Department of the Army
Washington, D.C.
ATTENTION: ENGWD

1. There are submitted herewith for review and approval ten (10) copies of the General Design Memorandum entitled "Local Protection Project, Naugatuck River, Housatonic River Basin, Waterbury and Watertown, Connecticut." The location and general plan of recommended improvements are designated. Minor adjustments will be required as more complete information becomes available from final design investigations.
2. The City of Waterbury and Town of Watertown, Connecticut, have indicated by letters of 10 April 1957 an intention of meeting all the requirements for local cooperation. Formal assurances of participation will be obtained from the Connecticut State Water Resources Commission during the preparation of final designs for the project as approved.
3. Local interests have expressed concern over the flood problem along the Naugatuck River in the vicinity of Waterbury which cannot be entirely relieved by completion of the authorized Thomaston Reservoir. The critical need for the recommended project near the Chase Brass Company plant is justified by the importance of this area to the local economy.
4. The plans and specifications will be prepared substantially in accordance with the Design Memorandum as approved. Copies of the plans and specifications will be forwarded to the Office, Chief of Engineers at the time of advertisement for the contract. Funds in the amount of \$9000 for preparation of plans and specifications, and in the amount of \$141,000 for construction will be required. The New England Division is currently reviewing the expenditure program for Fiscal Year 1958. Request for funds will be made at a later date. It is requested that approval of this design memorandum be expedited in order that negotiations with the State of Connecticut may be initiated.

Incl.
Design Memo (cys 1-10 incl)

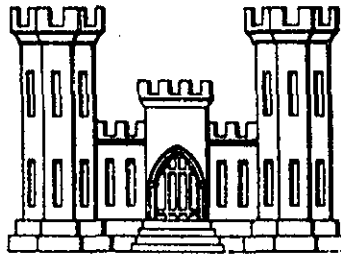

ALDEN K. SIBLEY
Brigadier General, U.S. Army
Division Engineer

HOUSATONIC RIVER FLOOD CONTROL

WATERBURY & WATERTOWN
LOCAL PROTECTION

NAUGATUCK RIVER, CONNECTICUT

GENERAL DESIGN MEMORANDUM



U.S. Army Engineer Division, New England

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Boston, Mass.

January 1958

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1	Naugatuck River Watershed Map
2	General Plan, Profile and Typical Sections
3	Peak Discharge - Frequency Curves, Naugatuck River
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Inclosures

Number

Assurances of Cooperation

- | | |
|---|--|
| 1 | City of Waterbury, Mayor's Endorsement, dated April 10, 1957 |
| 2 | City of Waterbury, Preliminary Assurance, received July 17, 1957 |
| 3 | Town of Watertown, Preliminary Assurance, received July 17, 1957 |
| 4 | Connecticut State Water Resources Commission, assurance in
letter dated November 10, 1957 |
| 5 | The Naugatuck Valley River Control Commission, letter of
endorsement dated October 31, 1957 |

LOCAL PROTECTION PROJECT
NAUGATUCK RIVER
HOUSATONIC RIVER BASIN
WATERBURY AND WATERTOWN, CONNECTICUT

GENERAL DESIGN MEMORANDUM

1. PERTINENT DATA

Physical Features

1. Location - In the Waterville section of the City of Waterbury, Connecticut on the Naugatuck River from the Chase Brass and Copper Company Dam, upstream to intersect with high ground east of Highway 8 and New York, New Haven & Hartford Railroad Bridge.

2. Type of Improvement - Channel Improvement, floodwall, and protective dike

3. Length of Improvement 1,220 feet

a. Dike	180 feet
b. Channel Widening and Deepening	800 feet
c. Concrete Flood Wall	80 feet
d. Stop log Structure	20 feet

4. Hydrology

a. Maximum Flood of Record (August 1955)	77,000 c.f.s.
b. Maximum Flood of Record modified by Thomaston Reservoir	25,000 c.f.s.
c. Project Design Flood	30,000 c.f.s.

5. Improved Channel Dimensions

a. Bottom width,	minimum 180 feet to 200 feet maximum
b. Side Slopes	Rock
	Earth
	4 vertical on 1 horizontal
	1 vertical on 2 horizontal

6. Dike Dimensions

- | | |
|---------------------------------|-------------------------------|
| a. Top width | 10 feet |
| b. Side slopes | 1 vertical on
2 horizontal |
| c. Freeboard above design flood | 3 feet |

Cost Estimates

1. First Costs

- | | |
|----------------|-----------|
| a. Federal | \$160,000 |
| b. Non-Federal | 1,000 |
| Total | \$161,000 |

2. Annual Costs

- | | |
|----------------|----------|
| a. Federal | \$ 5,650 |
| b. Non-Federal | 250 |
| Total | \$ 5,900 |

Benefits

- | | |
|----------------------------|-----------|
| 1. Average Annual Benefits | \$ 11,000 |
| 2. Benefit-Cost Ratio | 1.9 to 1 |

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
BOSTON 14, MASSACHUSETTS

LOCAL PROTECTION PROJECT
NAUGATUCK RIVER
HOUSATONIC RIVER BASIN
WATERBURY AND WATERTOWN
CONNECTICUT

GENERAL DESIGN MEMORANDUM

January 13, 1958

2. AUTHORITY

This Design Memorandum is submitted pursuant to authority contained in Section 205 of the Flood Control Act of 1948 as amended by Section 212 of the Flood Control Act of 1950 and Public Law 685, 84th Congress, 2nd Session. Further authority is contained in letter dated October 17, 1956 from the Chief of Engineers in reply to a letter dated September 27, 1956 from the Division Engineer, New England Division, subject: "Local Protection Project - Naugatuck River, Waterbury, Connecticut."

3. SCOPE OF DESIGN MEMORANDUM

3.1 Scope.- This Design Memorandum reviews the flood control problem in Waterbury and Watertown, Connecticut, from the vicinity of the New York, New Haven and Hartford Railroad Bridge downstream to the Chase Brass Company Dam, and submits a definite project for improvement of the Naugatuck River and construction of a short earth dike, a stop-log structure, and a floodwall in Watertown and the Waterville section of Waterbury, Connecticut.

3.2 Topographic Surveys.- A topographic survey of the flooded area along the Naugatuck River near the Chase Brass Company plant in the Waterville Section of Waterbury was made in March 1957.

3.3 Subsurface Explorations.- Explorations for the project consisted of a reconnaissance to study the general geology of the area, locate bedrock exposures and to determine excavation properties of materials present. Drive sample borings and auger borings were made at selected locations near the Chase Brass Works. No rock was encountered at the site of the dike and wall. Soils encountered were generally of an impervious nature, being principally sands and gravels with very few fines. Occasional micaceous silts were also encountered. Additional explorations and borings will be made, as needed for development of the final plans.

3.4 Flood Damage Surveys.- Flood damage surveys were completed following the floods of 1936, 1938 and 1955. The surveys consisted of the inspection of properties damaged by the flood and interviews with property owners and officials of the industries concerned, municipalities and the State of Connecticut. The results of flood damage surveys are summarized in Section 12 of this Design Memorandum.

3.5 Conference with Local Interests.-Close liaison has been maintained with state and town officials, local property owners and other interested parties. Plans for the protective works have been reviewed by the Naugatuck Valley River Control Commission, officials of the State of Connecticut, the City of Waterbury and Town of Watertown. Desires of the local interests are described in Section 15. All have expressed a strong desire for the immediate construction of flood protection works. During the course of the study they have furnished valuable information. The Mayor of Waterbury and the Board of Selectmen of Watertown have furnished preliminary assurances of local cooperation. Formal assurances will be furnished by the State of Connecticut through its Water Resources Commission prior to completion of the final design. No public hearings have been held. The Connecticut State Highway Department is cooperating in the local protection project by agreeing to ramp the grade of reconstructed Route 8 over the dike. In addition, provisions were made in the highway design for incorporating into the embankment an impervious cut-off layer and rock-fill slope protection.

4. PRIOR REPORTS

4.1 Preliminary Report.- Flood control improvements in the immediate vicinity of Waterbury, Connecticut, have not been included in any published survey report. A preliminary report authorized by House Document No. 308, 69th Congress, 1st Session, January 21, 1927, and printed as House Document No. 246, 72d Congress, 1st Session, February 10, 1932, "Housatonic River, Connecticut, Massachusetts and New York" is a preliminary report covering navigation, flood control, power development, and irrigation for the Housatonic River Basin.

4.2 Review Report.- House Document No. 338, 77th Congress, 1st session, July 31, 1941, prepared following the floods of 1936 and 1938 reviewed the previous report on the Housatonic River Basin and recommended the construction of Thomaston Reservoir on the Naugatuck River. With construction of Thomaston Reservoir no local protection was recommended as economically justified near Waterbury.

4.3 NENYIAC Report.- The unpublished report, "The Resources of the New England-New York Region" was prepared by the New England-New York Inter-Agency Committee under the directive contained in the Presidential Letter of October 9, 1950. This comprehensive inventory of resources included a master plan for regional planning, development, and conservation.

4.4 Reports of Other Agencies.- The Naugatuck Valley River Control Commission issued in March 1956 an "Interim Report on the Problem of Flood Control on the Naugatuck River and Tributaries and Adjacent Streams". Various other reports by planning boards and other town and State agencies have also been of value in determining experienced flood damage and suggesting methods of improvements.

5. DESCRIPTION OF AREA

5.1 Geography. - The City of Waterbury and Town of Watertown are located in the rocky, narrow valley of the Naugatuck River in midwestern Connecticut. The project area is divided by the boundary between the two communities, about four miles north of the center of the City of Waterbury. Connecticut State Highway Route 8 follows the river closely, crossing on several bridges, and forms the major artery for north-south traffic. The New York, New Haven and Hartford Railroad Devon-Winsted Branch serves the Naugatuck Valley, and the track also follows the bank of the river. The Naugatuck River above the dam of the Chase Brass Company drains a watershed of about 154 square miles on the easterly side of the Housatonic River Basin. The general direction of flow is southerly and downstream from the project. The river continues through Waterbury, Naugatuck, Beacon Falls, Seymour, and Ansonia to tidewater in the Housatonic River at Derby about $12\frac{1}{2}$ miles from Long Island Sound. The Naugatuck watershed is elongated, about 29 miles in length and with a maximum width of eight miles. A map of the basin is shown on Plate No. 1

5.2 Topography. - The Naugatuck River Basin is mountainous, and the stream pattern is basically fan-shaped with numerous short mountain brooks located on the steep side slopes. The river rises about six miles south of the Connecticut-Massachusetts State Line, near Norfolk, Connecticut, at an elevation of about 1,500 feet above sea level. The elevations along the periphery of the drainage area vary from about 400 feet to about 1,700 feet above mean sea level. From the headwaters to Torrington, about 13 miles, the fall is about 900 feet. In the remaining 16 miles to the project, there is an additional fall of approximately 200 feet to an elevation of about 300 feet mean sea level.

5.3 Geology. - The Naugatuck River occupies a relatively deep, narrow valley in the crystalline rocks of the Western Highland of Connecticut. Bedrock consists of pegmatite and mica schist, and is generally hard and sound. The strike of the bedrock is roughly north-south and the strata dip steeply to the southeast. The pre-glacial bedrock valley has been partly filled by glacial outwash on which the present stream flows above the rock floor of the old valley. Existing topography and the principal drainage pattern in the Naugatuck Valley near Waterville are essentially determined by the granitic bedrock surface and to a lesser extent by glacial deposits. Bedrock is exposed throughout the entire limits of the project; on the valley walls along the banks and at the upper limit of the work, steep rock cliffs on both banks severely limit the width of the valley. The stream traverses the glacial deposits between the valley walls in which degradation is still active, as evidenced by the movement and deposits of sediment during high water stages.

5.4 Maps.- The Naugatuck River Basin is mapped on standard quadrangles of the United States Geological Survey at a scale of 1:62,500, and on 15-minute quadrangles at a scale of 1:31,680. The U.S. Army Map Service Grid Zone 18T covers the Basin at a scale of 1:25,000. and the project is located in the upper portion of the Waterbury Sheet No. 6367 II SE.

6. CLIMATOLOGY

6.1 General.- The Naugatuck River Basin has a modified continental type climate. Variable weather conditions within the seasonal regimen are common, characterized by frequent but usually short periods of precipitation. The basin lies in the path of the prevailing westerlies and is exposed to the cyclonic disturbances that cross the country from west or southwest toward the east or northeast. Climatological data based on the U.S. Weather Bureau Stations at Waterbury, Connecticut, about 4 miles to the southward at about the same altitude and Norfolk, Connecticut about 30 miles to the north at about 1,100 feet higher in altitude, is representative of the basin.

6.2 Temperature.- Average monthly temperatures in the Naugatuck River Basin vary widely through the year with a mean annual temperature of approximately 47°F. Freezing temperatures can be expected from the middle of November to the end of March. At Waterbury, Connecticut, the average monthly temperatures range from 73°F. in July to 28°F. in January with 105°F. and -25°F. the extremes for the 67 years of record. At Norfolk, Connecticut the average monthly temperatures range from 69°F. in July to 23°F. in January with 93°F. and -15°F. the extremes for the 11 years of record. The mean, maximum, and minimum temperatures recorded each month at Norfolk and Waterbury, Connecticut are shown in Table 1.

TABLE 1

MONTHLY TEMPERATURES (Degrees Fahrenheit)

<u>Norfolk, Conn.</u>					<u>Waterbury, Conn.</u>		
<u>Elevation 1,380 ft., m.s.l.</u>					<u>Elevation 340 ft. m.s.l.</u>		
<u>11 Years of Record</u>					<u>67 years of Record</u>		
<u>Extremes</u>					<u>Extremes</u>		
<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	
January	23.3	62	-14	28.1	73	-19	
February	23.8	66	-15	28.3	70	-25	
March	30.2	77	-11	37.3	87	0	
April	44.0	80	6	48.3	92	11	
May	54.2	85	25	59.4	96	26	
June	62.9	91	35	68.1	101	33	

TABLE 1 (cont).

MONTHLY TEMPERATURES
(Degrees Fahrenheit)

	<u>Norfolk, Conn.</u> <u>Elevation 1,380 ft., m.s.l.</u> <u>11 Years of Record</u> <u>Extremes</u>			<u>Waterbury, Conn.</u> <u>Elevation 340 ft., m.s.l.</u> <u>67 Years of Record</u> <u>Extremes</u>		
	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
Month						
July	68.5	92	41	73.0	105	41
August	66.2	93	41	70.8	104	35
September	57.9	93	26	64.1	103	25
October	49.0	79	20	53.5	94	17
November	37.1	73	5	42.3	84	2
December	26.1	60	-5	31.2	70	-12
Annual	45.2			50.4		

6.3 Precipitation.— The mean annual precipitation over the Naugatuck River watershed is approximately 50 inches, uniformly distributed throughout the year. The maximum and minimum annual precipitation at Waterbury for 67 years through 1954 are 66.58 inches in 1901 and 31.21 in 1931. Waterbury records for 1955 are not available for the period August through December, but the annual precipitation has been estimated at approximately 65 inches. At Norfolk near the upper limits of the watershed, the total precipitation for 1955 was 76 inches with 23.67 inches and 17.49 inches observed during August and October, respectively. Table 2 summarizes the precipitation records at Norfolk and Waterbury, Connecticut.

TABLE 2

MONTHLY PRECIPITATION RECORD
(In Inches)

<u>Norfolk, Conn.</u> <u>Elevation 1,380 ft., m.s.l.</u> <u>11 Years of Record</u>				<u>Waterbury, Conn.</u> <u>Elevation 340 ft., m.s.l.</u> <u>67 Years of Record</u>		
<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	4.47	8.32	0.93	3.87	10.06	0.84
February	3.96	5.72	2.44	3.52	10.00	0.43
March	4.75	10.37	1.82	4.08	9.46	0.17
April	4.90	7.19	2.88	3.72	11.51	0.66
May	4.90	8.14	1.72	3.95	8.08	0.13
June	4.39	8.58	1.11	3.59	11.25	0.54
July	3.93	9.33	1.67	4.34	18.10	1.36
August	5.34	23.67	0.65	4.30	9.48*	0.90
September	4.34	9.25	0.92	3.66	12.90	0.90
October	4.21	17.49	1.86	3.46	8.83*	0.20
November	5.45	10.03	1.51	3.81	8.74	0.78
December	5.00	9.40	1.20	3.90	9.82	0.82
Annual	55.64*	76.00	39.68	46.20	66.58	31.21

* Probably exceeded in 1955

6.4 Snow.- The mean annual snowfall over the watershed varies from about 35" along the coast to over 80" in the headwater region. Snow cover reaches a maximum depth in late March with the water content in early Spring often reaching from 4" to 6". Monthly and annual snowfall for 35 years of record at Norfolk are tabulated in Table 3.

TABLE 3

MEAN MONTHLY SNOWFALL AT NORFOLK, CONNECTICUT
Elevation 1,380 ft., m.s.l.
(Average Depth in Inches)

<u>Month</u>	<u>Snowfall</u>	<u>Month</u>	<u>Snowfall</u>
January	18.5	July	--
February	20.9	August	--
March	15.6	September	--
April	5.7	October	0.3
May	0.3	November	6.2
June	-	December	11.9
Annual	----- 79.4		

6.5 Storms.- The rapidly moving cyclonic storms or "lows" that travel over the Naugatuck River Basin from the west or southwest produce frequent periods of unsettled, but not extremely severe weather. The region is also exposed to occasional coastal storms, some of tropical origin, that travel up the Atlantic coast and move inland over New England. The hurricanes of September 1938 and August 1955 were of this type. The precipitation which accompanied the latter storm averaged more than 13 inches in the upper watershed and 10 inches in the lower basin, falling on ground already saturated by more than 7 inches of rain during hurricane "Connie" the previous week. The thunderstorms which predominantly occur in the summer months produce heavy precipitation over relatively small areas. Due to the steep topography and a thin soil cover, a flood hazard exists in the narrow valleys of the Naugatuck River Basin from precipitation which can occur during any month of the year.

7. RUNOFF

7.1 Discharge Records.- The U.S. Geological Survey has published records of river stages and stream flow at three locations in the basin for various periods of time since 1918. The records are good to excellent, except during periods of ice when they are fair. Following major floods, additional peak-discharge data has been computed by the U.S. Geological Survey for many locations on the smaller tributaries. Stream flow records at the gaging stations are summarized in Table 4.

TABLE 4

STREAMFLOW RECORDS

Naugatuck River Watershed

<u>Location of Gaging Station</u>	<u>Drainage Area (Sq. Miles)</u>	<u>Period of Record</u>	<u>Discharge(c.f.s.)</u>		
			<u>Mean (1)</u>	<u>Max.(2)</u>	<u>Min.</u>
Naugatuck River near Thomaston	71.9	1930-1955	139	41,600	7
Leadmine Brook near Thomaston	24	1930-1955	46.7	10,400	0.08
Naugatuck River near City of Naugatuck	246	1918-1955	457	106,000	24

(1) Includes 1952 Water Year

(2) Instantaneous Discharge, August 1955

7.2 Runoff. - The flow data for the project was determined from the Thomaston gaging station records and high water marks. The months of greatest runoff are primarily March April and May as indicated by the gaging station record. The monthly distribution of runoff for the gaging stations near Thomaston and at Leadmine Brook is summarized on Table 5.

TABLE 5

MONTHLY RUNOFF
(In Inches)

Oct. 1931 - Sept. 1955

<u>Month</u>	<u>Naugatuck River</u> <u>near Thomaston, Conn.</u> (D.A. = 71.9 sq. mi.)			<u>Leadmine Brook</u> <u>near Thomaston, Conn.</u> (D.A. = 24.0 sq. mi.)		
	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	2.73	6.23	.54	2.79	6.05	.51
February	2.18	5.22	.63	2.33	5.55	.48
March	4.95	11.99	1.84	5.19	11.24	2.39
April	4.28	9.28	1.92	4.17	10.60	1.94
May	2.80	5.34	.97	2.76	5.72	1.11
June	1.71	3.60	.41	1.48	3.90	.26
July	1.05	4.93	.30	.85	5.28	.09
August	1.26	13.26	.39	.98	10.18	.03
September	1.08	6.55	.33	.97	5.26	.03
October	.89	3.41	.28	.81	3.25	.06
November	1.85	5.67	.27	2.06	6.74	.12
December	2.40	5.14	.49	2.54	4.51	.50
Annual	27.18	40.72	14.35	26.93	40.12	13.71

8. FLOODS OF RECORD

8.1 Flood Causes.- Outstanding floods on the Naugatuck River may result from early spring storms combined with melting snow, such as the flood of March 1936 or from summer or fall storms like the record flood of August 1955. In addition, local thunderstorms can cause serious flash floods on the smaller streams. Due to the steep topography and thin soil cover of the watershed which is highly conducive to rapid runoff, the project area is subject to serious flooding during any season of the year. During flood periods, the situation is aggravated by deposition of boulders, gravel and other debris which restricts the channel.

8.2 Historic Floods.- The storm of August 1955, resulting in the greatest flood of record on the Naugatuck River, was caused by heavy rainfall on ground already saturated by rainfall from hurricane "Connie" occurring during the previous week. The earliest flood of significance in the Naugatuck River Basin occurred in February 1691. Other significant floods of about the same magnitude were recorded in November 1853 and April 1854. The flood of October 1869 was the greatest prior to 1900 with other serious floods in January 1891.

8.3 Major Floods of Record.- Since 1900 there have been many floods with major ones occurring in November 1927, March 1936, September 1938, New Year's 1949, and August and October 1955. Table 6 is a summary of the peak discharges at the three gaging stations for the six major floods in the past 30 years.

TABLE 6

MAJOR FLOODS - NAUGATUCK RIVER BASIN

U.S.G.S. Gage		Naugatuck River near Thomaston	Leadmine Brook near Thomaston	Naugatuck River at Naugatuck
Drainage Area (Sq. Mi.)		71.9	24	246
Flood		Peak Discharge (c.f.s.)	Peak Discharge (c.f.s.)	Peak Discharge (c.f.s.)
November	1927	10,000 (est)	5,000 (est.)	26,000
March	1936	6,590	2,680	23,340
September	1938	9,970	3,050	25,300
January	1949	10,200	5,150	28,500
August	1955	41,600	10,400	106,000
October	1955	8,800	3,100	35,000

9. FLOOD FREQUENCY

The frequency of peak discharges on the Naugatuck River was determined from records of three U.S. Geological Survey gaging stations at Thomaston, Leadmine Brook, and Naugatuck in accordance with procedures described in Civil Works Engineer Bulletins 51-1 and 51-14. On the basis of a regional study for all of New England, a skew factor of 1.0 was applied to the flood distribution. The natural discharge-frequency curves for the project site on the Naugatuck River are shown on Plate No. 3.

10. STANDARD PROJECT FLOOD

10.1 Hydraulics of Flood Problem.- The flood problem is produced by poor channel hydraulics in the Naugatuck River, just upstream of the Chase Brass Company. Here the river makes a sharp 90-degree bend to the right and passes under a railroad bridge, as shown on Plate No. 2. The bridge piers are normal to the track, but are in poor alignment with the direction of flow. Head losses are indeterminate, but the complex flow conditions caused by the bend, the bridge piers, and the debris caught on the piers produced flood stages sufficiently high to overflow the left bank and to flow down the highway and railroad track east of the Chase Brass Company. Prior to 1955, the plant was damaged in September 1938 and December 1948 from river flows of about 15,000 c.f.s.

In August 1955 the flow was approximately 77,000 c.f.s. Of this total flow, it is estimated that at least 20,000 c.f.s. left the river and flowed down the railroad track on the east side of the buildings. Debris piled up against the railroad bridge, which remained standing, although completely submerged. After the August flood, the river was cleaned up during disaster relief operations and the material was spoiled along the low point on the bank at the railroad crossing. The spoil embankment proved of value when, in October 1955, a flood approximating the second largest of record with an estimated peak discharge of 23,000 c.f.s. was prevented from going down the tracks. The October 1955 flood did not overtop the wall on the river side of the plant, although records indicate that it came within six inches of the top at several locations. This wall has since been raised about three feet.

High stages in the river, along the west side of the plant, are produced, in part, by insufficient cross-sectional area. Rock outcrops along the right bank constrict the channel, raising flood stages upstream to the railroad bridge. Excavation of these rock outcrops will increase the channel capacity and increase the protection provided by the Chase Brass Company's wall on the left bank. The improvements will also lower the backwater stages in the vicinity of the railroad bridge.

10.2 Standard Project Flood.- A standard project flood was determined for the Naugatuck River during analysis for the interim report on the Naugatuck River below Thomaston, Connecticut, now in preparation as a part of the Northeast Flood Studies. The standard project flood peak for the project site was determined to be 97,000 c.f.s. which is about 25 percent greater than the estimated 77,000 c.f.s. experienced at the Chase Brass Company in August 1955. The authorized Thomaston Reservoir would reduce the standard project flood to 40,000 c.f.s., and in a recurring flood of the magnitude of August 1955 the modified flow at the site would be 25,000 c.f.s.

11. PROJECT DESIGN FLOOD

The design flood for the project is 30,000 c.f.s. This discharge, which is 10,000 c.f.s. less than the standard project flood modified by Thomaston Reservoir, was computed to be the safe channel capacity of the river along the existing flood wall at the Chase Brass Company. The adopted design flow of 30,000 c.f.s. is 20 per cent greater than the flood of August 1955 as modified by the authorized Thomaston Reservoir.

12. FLOOD LOSSES

12.1 General. - The Naugatuck Valley suffered by far the greatest loss of any area in southern New England during the catastrophe of August 1955. Within this valley, one of the hardest hit locations was that of the Chase Brass Works in the Waterville Section of Waterbury, where losses reached a staggering \$19,000,000. This same area suffered serious but comparatively small flood damage in 1938 and again in 1948, which was the previous flood of record.

In August 1955, flood waters surged into this area directly over the wall adjacent to the river and also through the draw between the railroad and highway right-of-way near the upstream limit of the project area. Damage to structures and equipment at the brass works was particularly severe due to the velocity of the debris-laden water estimated at 16 feet in depth. The railroad connecting Waterbury and Torrington and also the highway in this area were seriously damaged. After completion of the Thomaston Reservoir flood stages of the magnitude of August 1955 would still pour into the area through the draw near the upstream limit of the area and cause large scale damage.

12.2 Annual Losses.- Estimated recurring flood losses have been converted to annual losses to provide a basis for comparing annual benefits to annual costs. These annual losses have been determined in accordance with Standard Corps of Engineers practice of utilizing recurring stage-damage, stage-discharge and discharge-frequency relationships.

Under present conditions the annual losses in the area amount to \$430,000. Assuming flood-stage reductions effected by upstream reservoir storage at Thomaston annual losses would be reduced to \$33,000. Examples of curves used in the computation of annual losses are shown on Plate No. 4.

13. OTHER CORPS OF ENGINEERS FLOOD CONTROL PROJECTS

13.1 Emergency Flood Relief.- The Naugatuck Valley was subjected to severe losses during the floods of 1955. Under the authority of Public Law 875, the channel was restored to its pre-flood condition, but permanent improvements were not authorized or made under this authority. Gravel deposits and obstructions were removed from the stream and the washed-out left bank was filled, rocks washed up onto the road were removed and placed for protection of the river bank slopes.

13.2 Local Protection Projects under the provisions of Section 205 of the Flood Control Act of 1948 as amended are being considered for Torrington, Connecticut, about 16 miles upstream from this project. Construction is under way along the East Branch, and study is being completed for a project along the West Branch. Neither project will affect the Waterbury project.

13.3 Thomaston Dam and Reservoir.- The Thomaston Dam and Reservoir Project was authorized by the Flood Control Act, approved 22 December 1944, Public Law 534, 78th Congress, 2nd Session. This project is located on the Naugatuck River about 30.4 miles above its confluence with the Housatonic River at Derby, Connecticut, and 1.6 miles above U.S. Routes No. 6 and 202, in the town of Thomaston, Connecticut, about 7 miles upstream from the project site. This dam will provide storage for 42,000 acre feet, equivalent to 8.1 inches of runoff from the drainage area of 97.2 square miles. Construction of the project was initiated in 1957.

13.4 East Branch Reservoir and Hall Meadow Brook Reservoir. - East Branch Reservoir was recommended for construction in the interest of flood control. It would be located on the East Branch of the Naugatuck River about three miles above its confluence with the West Branch in Torrington, Connecticut. An earth-fill dam would provide storage of 5,150 acre-feet, equivalent to 10.5 inches of runoff from its drainage area of 9.25 square miles. Hall Meadow Brook Reservoir was recommended for construction in the interest of flood control on Hall Meadow Brook about $\frac{1}{2}$ mile above its confluence with Hart Brook, $5\frac{1}{2}$ miles above the City of Torrington, Connecticut. An earth-fill dam would provide for storage of 7,200 acre-feet, equivalent to 11.1 inches of runoff from its drainage area of 12.2 square miles. Each reservoir is designed primarily for the protection of communities upstream from Thomaston Reservoir. The projects are not considered to affect the design flood at the Waterbury project. Both projects are contained in House of Representatives Document No. 81, 85th Congress, 1st Session, dated January 8, 1957, on which further legislation is pending.

13.5 Northfield and Branch Brook Reservoirs.- These two reservoirs are currently being investigated under the Northeast Flood Studies program. They would be located on tributaries of the Naugatuck River between Thomaston Reservoir and the Waterbury and Watertown Project site, and would control drainage areas of 5.7 square miles and 22.8 square miles, respectively. In combination with Thomaston Reservoir, the peak discharge in the Naugatuck River at Waterbury would be reduced to 30,000 c.f.s., equivalent to the design flood for the Waterbury and Watertown project.

14. IMPROVEMENTS BY OTHER FEDERAL AND NON-FEDERAL AGENCIES

14.1 Bank Protection.- Since the flood of August 1955, the Chase Brass Company has raised the wall along the left bank in an effort to protect its property from direct river overflow. The company has placed grouted riprap of heavy stone around the curved bank above the railroad bridge and has built a stop-log structure on the south abutment. The raised wall is not effective against flows passing through the draw on the left bank upstream of the railroad bridge by overtopping or by-passing the grouted rip-rap and railroad stoplog structure. Neither is it effective against the project design flood flow without additional improvement.

14.2 Route 8 was rebuilt by the State of Connecticut along the original alignment immediately after the flood. Plans have been made by the Connecticut State Highway Department for a major reconstruction of this principal traffic artery which would include ramping it over the proposed dike.

14.3 The New York, New Haven & Hartford Railroad has repaired the flood damage to the bridge across the Naugatuck River with a reinforced concrete abutment as a replacement for the original stone masonry abutment.

15. IMPROVEMENTS DESIRED

The citizens and manufacturers of Waterbury and Watertown are very desirous of preventing future losses to their homes and manufacturing plants, not only in property damage, but also in loss of wages caused by industrial shutdown. They believe that the proposed project as outlined herein will be beneficial to their communities by prevention of future recurrence of the heavy property losses occasioned from the past floods.

16. FLOOD PROBLEMS AND SOLUTIONS CONSIDERED

16.1 Flood Problem. - The Naugatuck River Basin is susceptible to floods caused by heavy rains or a combination of heavy rains and melting snow. Runoff is rapid owing to generally steep topography and a thin soil cover. Infiltration losses are light during heavy rainfall. The industrial basis of the Waterville Section of the City of Waterbury is the Chase Brass Company. The commercial center of Waterville extends on the left bank downstream of the plant. In this area are the public buildings, stores and small service industries of local importance. Extending eastward from the river to high ground, as well as downstream, are numerous tenements, apartment buildings and single homes typical of industrial housing areas. This developed area extends up the south slopes of Fort Hill Park. Properties in this area were severely damaged in 1955 by floodwater coming down the railroad track and Route 8. A recurrence of the floods of previous years, especially that of 1955 would again cause great damage to property with possible loss of life.

16.2 Solutions Considered. - Various possible measures for protection of the Waterville section of Waterbury were considered. The Chase Brass Company's dam is essential to plant operation and its removal is not feasible at this time. Raising the grade of the railroad track to provide for a larger bridge waterway is economically infeasible, as are large concrete or masonry floodwalls. Raising Route 8 to cross over the dike is more dependable and less costly than a concrete stop log structure across the highway. The combination of dike, stop log structure at the railroad and a limited extent of concrete floodwall described in Section 17 was found to be the most feasible plan.

16.3 Reservoirs. - Completion of the Thomaston Reservoir now under construction will reduce the flood water levels to the extent that local protection works can be constructed to reasonable heights and be economically justified. Reservoirs proposed along upstream tributaries, in the event that construction is subsequently authorized, would increase the degree of protection provided by local works constructed at this time.

17. DESCRIPTION OF PROPOSED IMPROVEMENTS

17.1 General.- The most feasible plan for local protection as described in subsequent paragraphs includes the following principal features:-

- a. Channel Improvement
- b. Earth Dike
- c. Reinforced concrete floodwalls
- d. Stop logs

17.2 Channel Improvement. - The Naugatuck River narrows near Station 18+25 between ledge on the right bank and the existing wall along the left bank. The design discharge would overtop the wall and damage the Chase Brass Company. It is proposed to widen the channel to lower the water surface elevation below the top of the wall. A minimum bottom width of 200 feet would extend for about 800 feet.

17.3 Earth Dike. - An earth dike would extend approximately 180 feet from the railroad to the highway on the left bank of the river. The dike would have a top width of 10 feet and side slopes of 1 vertical on 2 horizontal. A ten-foot berm would be made at the top of the existing grouted rip-rap slope. A layer of impervious material and a layer of rock fill would be provided on the riverside of the dike along with necessary graded filter layers. A toe drain and new catch basins would be provided landward of the dike. The top elevation would provide a minimum of three feet of freeboard above the project design flood stage. Construction of the dike would be coordinated with the reconstruction of Route 8 to provide continuity of flood protection to the rock slope east of the roadway. A maximum of dependability in the protective system is assured by ramping the highway grade above flood levels in lieu of a stoplog structure. Prevention of seepage requires an impervious layer, similar to that used in the dike, to Elevation 310.0 along the riverside of the highway embankment. This impervious layer would extend as a core through the highway embankment to the rock cliff on the east side of Route 8. Side slopes would be protected to Elevation 310.0 with rock fill on gravel bedding. The proposed channel excavation would provide broken rock greatly in excess of requirements for slope protection at the project. This surplus will be spoiled. It is anticipated that construction of the highway embankment will precede construction of the local protection project as the highway design was completed in November 1957. The State Highway Department has requested reimbursement from the United States for the construction costs of the flood protective project features incorporated into the highway embankment. These costs are estimated to be under \$10,000. It is proposed that the excess costs to be paid by the State for the impervious cut-off construction and protective rock fill in the highway embankment as an essential element of the flood protection would be repaid by the United States. An agreement to this effect in accordance with the provisions of Section 701 h-1 of the United States Code would be negotiated with the State of Connecticut after the proposed project is authorized if time permits before award of the construction contract. Location of the dike is indicated in Plate No. 2.

17.4 Reinforced Concrete Floodwall. - An 80-foot length of reinforced concrete floodwall will be constructed downstream from the railroad bridge abutment to tie into the existing masonry wall. Preliminary subsurface explorations were made to determine probable foundation conditions, and no rock for foundations has been encountered. Stability of the existing wall will be analyzed and additional explorations will be made as required for preparation of final design. Location of floodwall is shown on Plate No. 2.

17.5 Stop Log Closure. - A 20-foot stop log structure would be provided at the railroad for use in time of floods. The structure would be designed in cooperation with the railroad. Stop logs used for closure would be stored when not in use in a 10' x 26' building of semi-portable metal construction located in close proximity to the stop log structure. Location and detail of stop log structure is indicated on Plate No. 2.

17.6 Hydraulic Design

17.6.1 Water Surface Elevations. - Water surface profiles for various flows were developed from backwater computations starting with a stage-discharge relation computed for Chase Brass Company Dam. The back-water computations assumed an "n" value of 0.035. Backwater computations were based on Manning's Formula as outlined in Engineering Manual for Civil Works Construction, Part CXIV, Chapter 9. A two-foot head loss for the design discharge was assumed at the railroad bridge due to the obstruction of the structure, poor alignment of its piers relative to the river flow, possible effects of debris and super-elevation from the sharp curvature of the channel.

17.6.2 Dike and Floodwall. - With the design discharge of 30,000 c.f.s., after the channel improvement the water surface elevation was computed to drop from Elevation 307.0 to Elevation 305.0 m.s.l. in passing the railroad bridge. This reduces the height of the dike and would permit a top elevation of 310.0 for the dike and floodwall with a 3-foot freeboard.

17.6.3. Velocities. - Computed average velocities in the Naugatuck River for the project design flood vary between 7 and 13 feet per second within the project limits. These velocities will occur for a relatively short interval of time during the peak discharge of the design flood. Because of the rocky nature of the banks and stream bed, rock fill is not necessary on the slope except on the curved portion of the channel. The effect of super-elevation at the curve above the bridge was determined to be 0.4 foot. A two-foot head loss at the bridge was considered sufficiently conservative to include allowances for the super-elevation and no additional height would be required.

17.6.4 Upstream Flood Levels. - The effect of the project on upstream flood stages is relatively unimportant. For discharges of up to about 25,000 c.f.s., the channel improvement will lower stages upstream from the railroad bridge by about one foot. This beneficial effect will diminish to zero with a flow in excess of the design flood.

17.7 Sources of Construction Materials.

17.7.1 General.- Materials for construction of the dikes would be obtained from the channel and from deposits located within five miles of the project. Disposal areas for materials unsuitable in the work have been designated on the right bank of the Naugatuck River downstream from the railroad bridge.

17.7.2 Concrete Aggregates.- The aggregates for the small quantity of concrete required for this project can be supplied from several commercial sources within a 20-mile haul radius. These sources were recently approved for use in structures for Thomaston Dam and are reported in detail in Design Memorandum No. 4, dated March, 1957, for that project.

18. MULTIPLE-PURPOSE FEATURES

The Waterbury-Watertown Local Protection Project is designed solely for flood protection and contains no multi-purpose features.

19. RECREATIONAL DEVELOPMENT

The project is not suitable for recreational development.

20. REAL ESTATE

The City of Waterbury and the Town of Watertown, as the responsible local agencies (see Paragraph 26), will furnish the lands, easements, and rights-of-way required for the construction, including disposal areas for excavated materials not used in the dike. The responsible authorities have indicated that the lands and assurances will be furnished as required.

21. ESTIMATES OF FIRST COST AND ANNUAL CHARGES

The total estimated first cost of the Waterbury-Watertown Local Protection Project is \$161,000 with annual charges estimated at \$5,900. First costs to the United States and to local interests are estimated at \$160,000 and \$1,000 respectively. Federal annual charges would amount to \$5,650 and Non-Federal to \$250.

Estimates have been prepared on the basis that local interests have agreed to assume the entire cost of any relocations, furnish all lands and rights-of-way necessary for construction and operation of the project including disposal areas for excavated materials not used in the dike, and in addition, make a cash contribution of part of the construction cost in the event that the Federal cost were to exceed the statutory limitation of \$400,000. Local interests would also be required to maintain and operate the project after completion.

Unit prices used in estimating costs are based on average unit prices for recent similar work in the same general region. The adopted unit prices are based on the 1957 price level and include related minor items of work which do not appear in the cost estimates. Annual charges are based on an annual interest rate of 2.5 percent, with amortization of the project cost distributed over a 50-year period. A summary of first costs and annual charges is given in Table 7.

TABLE 7
COST ESTIMATE
First Costs - (1957 Base)

Federal Cost, Construction Contract

<u>Item</u>	<u>Unit</u>	<u>Quan.</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
Clearing of Site	L.S.	1	L.S.	\$ 2,300.
Excavation, Rock	Cu. Yd	12,000.	\$ 5.80	69,600.
Excavation, Structural & Backfill	Cu. Yd	440.	3.75	1,650.
Excavation, Unclassified	Cu. Yd	1,500.	1.	1,500.
Impervious Borrow	Cu. Yd.	550.	3.	1,650.
Random Fill Embankment	Cu. Yd.	2,000.	1.50	3,000.
Rock Fill on Gravel Bedding	Cu. Yd.	1,100.	6.00	6,600.
Concrete, Reinforced	Cu. Yd.	120.	75.00	9,000.
Stoplogs and storage	L.S.	1	L.S.	4,400
Drainage	L.S.	1	L.S.	3,000.
Loam, Seeding & Rolling	S.Y.	240.	0.75	180.
Miscellaneous	L.S.	-	L.S.	880.

Route 8 Cutoff (1)

Impervious Borrow	Cu. Yd.	1,600.	3.	4,800.
Rock Fill on Gravel Bedding	Cu. Yd.	240.	6.	1,440.
Sub Total				\$110,000
Contingencies				21,000
Total construction costs				\$131,000
Engineering & Design				19,000
				\$150,000
Supervision & Administration				10,000
				\$160,000
TOTAL ESTIMATED FEDERAL FIRST COST				\$160,000

Non Federal

Land Acquisition	\$	600
Relocation of Lighting		200
Relocation of Switch Stand		200
TOTAL ESTIMATED NON-FEDERAL FIRST COST	\$	1,000

Annual Charges

Federal

Interest (2.5% on \$160,000)	\$	4,000
Amortization (1.026% on \$160,000)		1,650
Total Federal Annual Charges	\$	5,650

Non-Federal

Interest (2.5% on \$1,000)	\$	25
Amortization (1.026% on \$1,000)		10
Maintenance		215
Total Non Federal Annual Charges	\$	250

Total Annual Charges	\$	5,900
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(1) Proposed reimbursement to State of Connecticut

22. ANNUAL BENEFITS

The Waterbury-Watertown Local Protection Project would derive substantial benefits by preventing floodwaters up to the record flood stage from entering the protection area. These flood damage prevention benefits represent the difference between average annual losses remaining in the protection area after discharge reductions by Thomaston Reservoir and the average annual losses remaining after local protection. Annual benefits attributable to the project through reduction of flood damages amount to \$11,000.

23. COMPARISON OF BENEFITS AND COSTS

Average annual benefits for the Waterbury (Waterville) and Watertown Local Protection project are estimated at \$11,000 and average annual costs are estimated at \$5,900. The resulting ratio of benefits to costs is 1.9 to 1.0.

24. SCHEDULES FOR DESIGN AND CONSTRUCTION

24.1. Design.—It is estimated that preparation of contract plans and specifications for the project will require four months. The estimated cost is \$9,000.

24.2 Construction.—Construction of the project can be accomplished in one construction season of six months duration under a single contract. All funds for the project should be available for obligation prior to award of the contract to permit completion in one construction season which includes portions of two successive years. Expenditures are estimated as follows:

<u>Fiscal Year 1957</u>		
Allotments to date (Design Memorandum)		\$10,000
<u>Future Work</u>		
Planning		9,000
Construction		<u>141,000</u>
Total Future Work		\$ 150,000
Total		\$ 160,000

25. OPERATION AND MAINTENANCE

Maintenance of the project and operation of the stop log structure will be the responsibility of local interests (see Paragraph 26). Periodic inspections will be made to see that adequate maintenance is performed in accordance with regulations prescribed by the Secretary of the Army. It is estimated that maintenance of the project will cost local interests \$215 annually.

26. LOCAL COOPERATION

In accordance with Section 3 of the Flood Control Act of 1936, local interests would be required to provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction and operation of the project; hold and save the United States free from damages due to construction work; and maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army. The responsibility for furnishing disposal areas for excavated materials not used in the dikes and for the relocation or modification of highways and utilities would rest with local interests under the requirements of lands, easements, and rights-of-way. Local interests would also be required to furnish the added assurance that they would contribute to the United States all necessary funds over and above the Federal cost limitation of \$400,000 if it is later found that the total construction cost would exceed that amount.

There is an intense desire for flood protection in Waterbury and Watertown, Connecticut. City and Town officials have indicated a willingness to fulfill the conditions of local cooperation. Letters from the City and Town authorities which constitute preliminary assurances are included herein as Inclosures No. 1, No. 2 and No. 3. The Connecticut State Water Resources Commission will furnish the formal assurances during final design as noted in letter of November 19, 1957, Inclosure No. 4.

27. COORDINATION WITH OTHER AGENCIES

Plans for the protective works in Waterbury and Watertown have been reviewed by officials of the State of Connecticut, the City of Waterbury and the Town of Watertown. Their endorsement of the proposed plan is indicated by letter of April 10, 1957 from the Mayor of Waterbury and October 31, 1957 from the Naugatuck Valley River Control Commission. These letters are included herein as Inclosure No. 1 and Inclosure No. 5. The project has no effect on hydroelectric power generation, recreation, pollution abatement or other collateral purposes. Plans have been furnished for information to the Fish and Wildlife Service of the U.S. Department of the Interior and to the U.S. Bureau of Public Roads. Coordination with the Connecticut State Highway Department is described in Paragraph 3.5. The Soil Conservation Service of the U.S. Department of Agriculture considers the proposed project will have no effect on their prospective programs.

28. CONCLUSIONS

It is concluded that the Naugatuck River produces major flood damages in the Waterville Section of the City of Waterbury on the left bank from the New York, New Haven and Hartford Railroad bridge downstream to the American Brass Company dam. This area faces the continuing threat of frequent heavy damages in the future and protection can be provided most suitably by construction of the Waterbury-Watertown Local Protection Project at a total estimated first cost of \$161,000. This plan would afford protection from floods about 20% greater than the flood of record as modified by the authorized Thomaston Reservoir, and is economically justified by a ratio of annual benefits to annual costs of 1.9 to 1.0. The threat of recurrent damaging floods makes immediate construction of the project imperative.

29. RECOMMENDATION

Authorization for negotiating an agreement with the State of Connecticut in repayment of costs for the highway cut-off and bank protection is requested. It is recommended that the project as submitted in this report be authorized by the Chief of Engineers under the provisions of Section 205 of the Flood Control Act of 1948, as amended.

EDWARD O. BERGIN
MAYOR



RAYMOND J. FITZPATRICK
EXECUTIVE SECRETARY

OFFICE OF THE MAYOR
CITY OF WATERBURY
CONNECTICUT

April 10, 1957

Mr. George O. Evans, Area Engineer
Corps of Engineers, U.S. Army
P. O. Box 1422
Springfield, Massachusetts

Dear Mr. Evans:

This will give you official notice of the City of Waterbury's intention to supply full cooperation in the plan for the local protection project known as the Waterville project.

The project has my full endorsement as Mayor of the City of Waterbury.

The necessary confirming vote will be secured at the earliest possible date. Local details of the necessary arrangements are now being worked out.

Yours very truly,

Edward D. Bergin
Mayor

EDB/r

Inclosure No. 1

CITY OF WATERBURY

Division Engineer
Corps of Engineers
U.S. Army
150 Causeway Street
Boston, Mass.

Dear Sir:

The Board of Aldermen of the City of Waterbury has reviewed the general plan for the local protection project for the Waterville Project, and is willing to meet the requirements for local cooperation. It is understood that official action by the Town will be required if the project is approved and before construction can be initiated. It is understood that the conditions of local cooperation are:

- a. To furnish all rights of way, easements and lands free of all costs to the Federal Government.
- b. To hold and save the United States, its officers and agents harmless from all claims occasioned by the work.
- c. To maintain and operate the completed works subject to the regulations established by the Secretary of the Army.
- d. To assume all costs for modifications and relocations of sewer, water, drainage, electric and other utilities made necessary by the work.

CITY OF WATERBURY

By Edward J. Berghin
Mayor

TOWN OF WATERTOWN, CONN.

Division Engineer
Corps of Engineers
U.S. Army
150 Causeway Street
Boston, Mass.

Dear Sir:-

The Board of Selectmen of the Town of Watertown, has reviewed the general plan for the local protection project for the Waterville Project, and is willing to meet the requirements for local cooperation. It is understood that official action by the town will be required if the project is approved and before construction can be initiated. It is understood that the conditions of local cooperation are:

- a. To furnish all rights of way, easements and lands free of all costs to the Federal Government.
- b. To hold and save the United States, its officers and agents harmless from all claims occasioned by the completed work.
- c. To maintain and operate the completed works subject to the regulations established by the Secretary of the Army.

xxxxxxnecessaryxxconstructionsxxcostxxinxxexcessxxofxxthe
Federal limitationxxofxx\$400,000.00xx

- c. To assume all costs for modifications and relocations of sewer, water, drainage, electric and other utilities made necessary by the work.

Signed:

Wilhelm Hengst
Michael J. Brown
Joseph Masi
Board of Selectmen
Town of Watertown, Conn.

Inclosure No. 3



STATE OF CONNECTICUT
WATER RESOURCES COMMISSION
STATE OFFICE BUILDING HARTFORD 15, CONNECTICUT

November 19, 1957

Division Engineer
Corps of Engineers, U. S. Army
New England Division
150 Causeway Street
Boston 14, Massachusetts

Attention: Gardner W. Hicks

Re: Chase Brass Company
Waterville, Connecticut
Flood Protection Project
Naugatuck River

Gentlemen:

This will refer to our recent telephone conversation regarding state assurances necessary for carrying out the flood protection project at the Chase Brass Company plant in Waterville, Connecticut.

The Commission reviewed this matter and voted to advise that it would approve granting the necessary assurances to carry out this project.

Very truly yours,

A handwritten signature in cursive script, reading "William S. Wise".

William S. Wise
Director

WSW/jb

Inclosure No. 4



STATE OF CONNECTICUT
THE NAUGATUCK VALLEY RIVER CONTROL COMMISSION
ONE CENTRAL AVENUE
WATERBURY, CONNECTICUT

PLAZA 5-0175

October 31, 1957

Lt. Colonel Miles L. Wachendorf
Corps of Engineers, U.S. Army
150 Causeway Street
Boston 14, Mass.

Dear Colonel:

I have delayed answering your letter of October 23 which enclosed drawings showing the local flood protection project proposed for the vicinity of the Chase Brass & Copper Company plant in the Waterville section of Waterbury and Watertown, Connecticut "Plate No. 2, Revised October 16, 1957, and entitled 'Housatonic River Flood Control'", until our engineers could view the site and analyze the proposal. These things have now been completed.

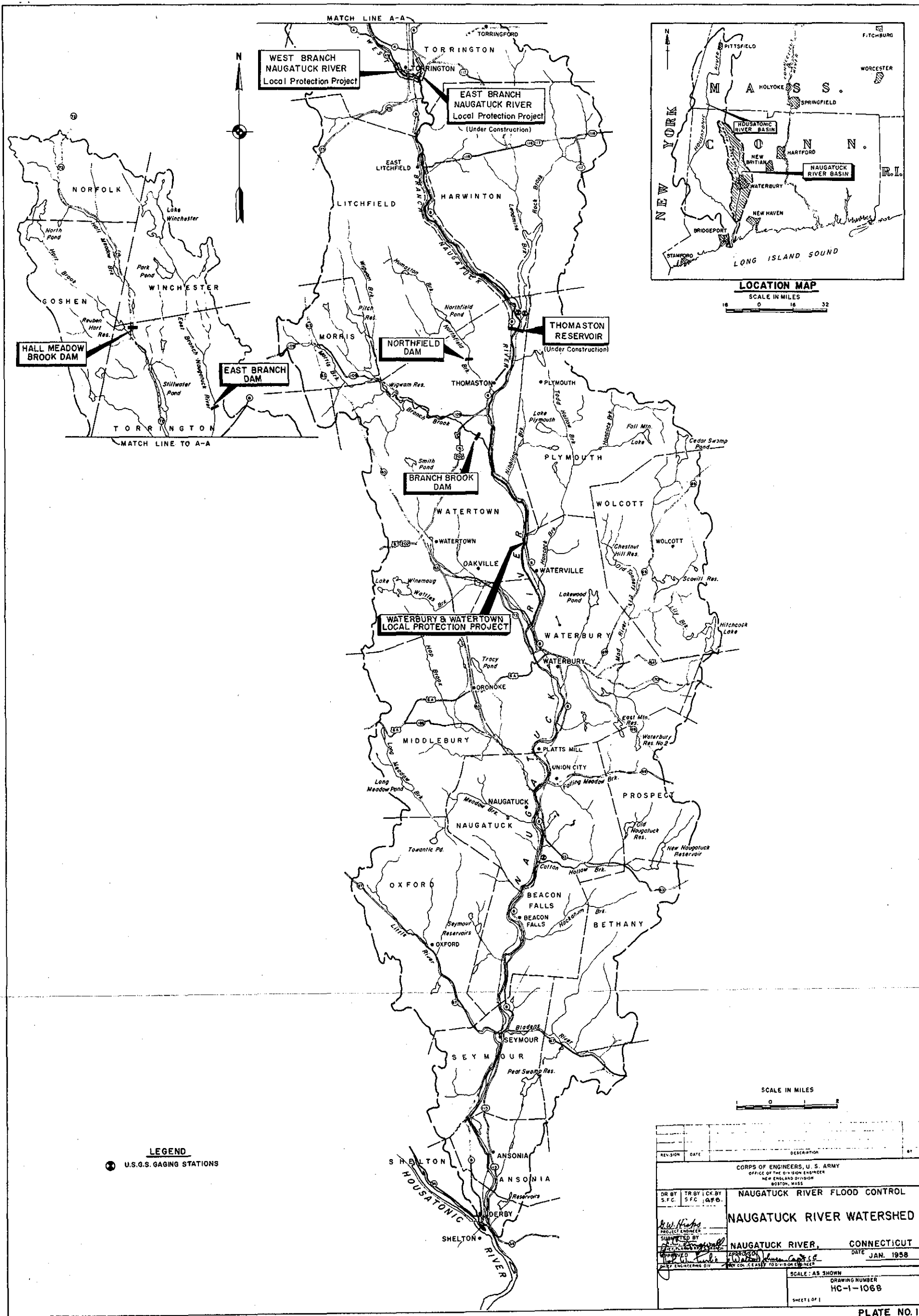
The improvement in the dike at the very north end outlined will be of real advantage toward the protection of the Waterville section below it. It is important that the State program of highway improvement on Thomaston Avenue in the area adjacent to the dike be made in such a way that the road elevation at this point will be consistent with the dike elevation of 310 feet above mean sea level. The widening of the river channel shown between locations 14 ~~+~~ 00 and 21 ~~+~~ will be a real protection to the Chase Plant in case of high river flow. To repeat, the overall program outlined on this map is considered to be vital to the protection of the Waterville area and the Chase Plant and we are wholly in agreement with its details.

Yours very truly,

Chairman

C.L. Eyanson/ac

Inclosure No. 5

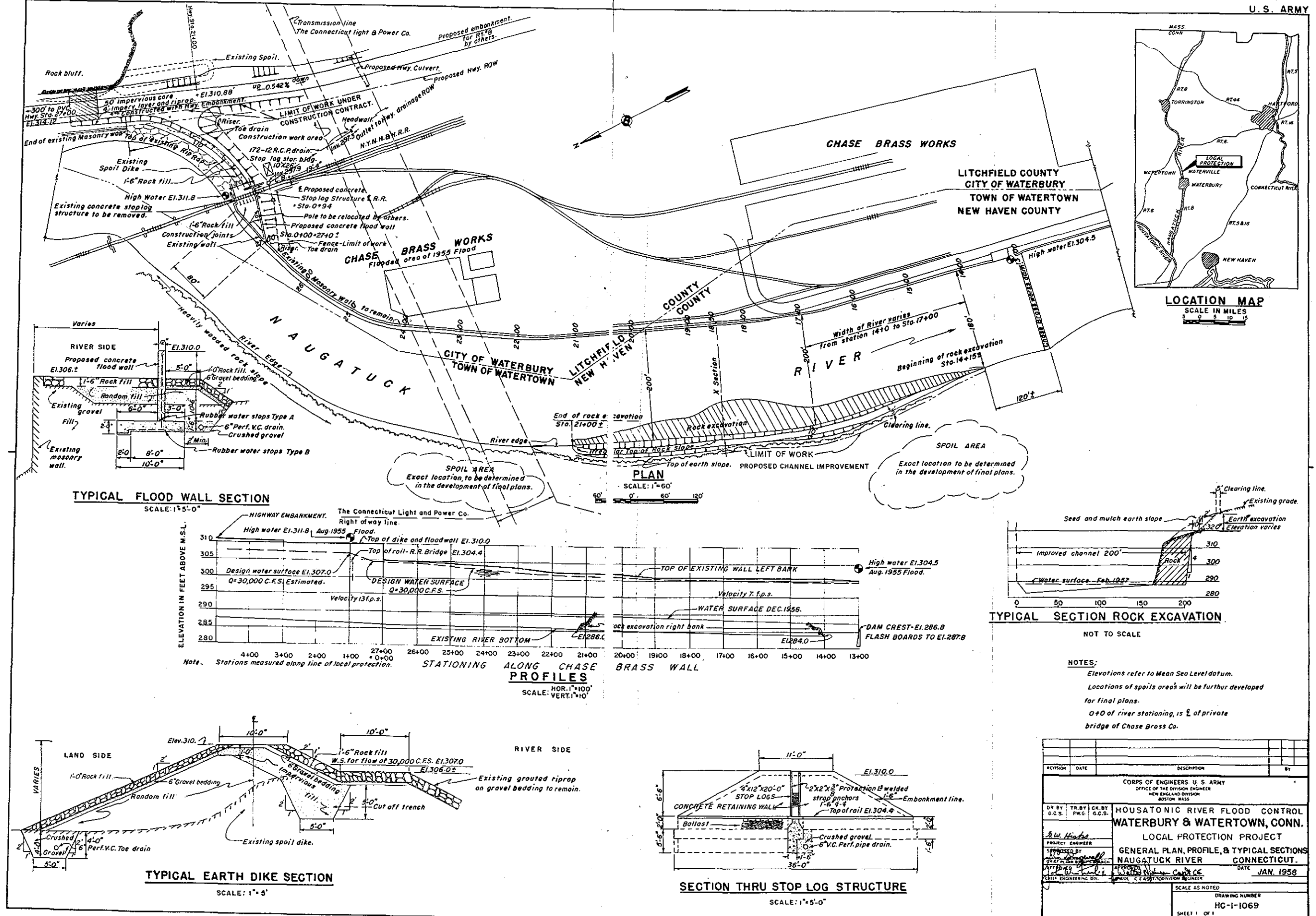


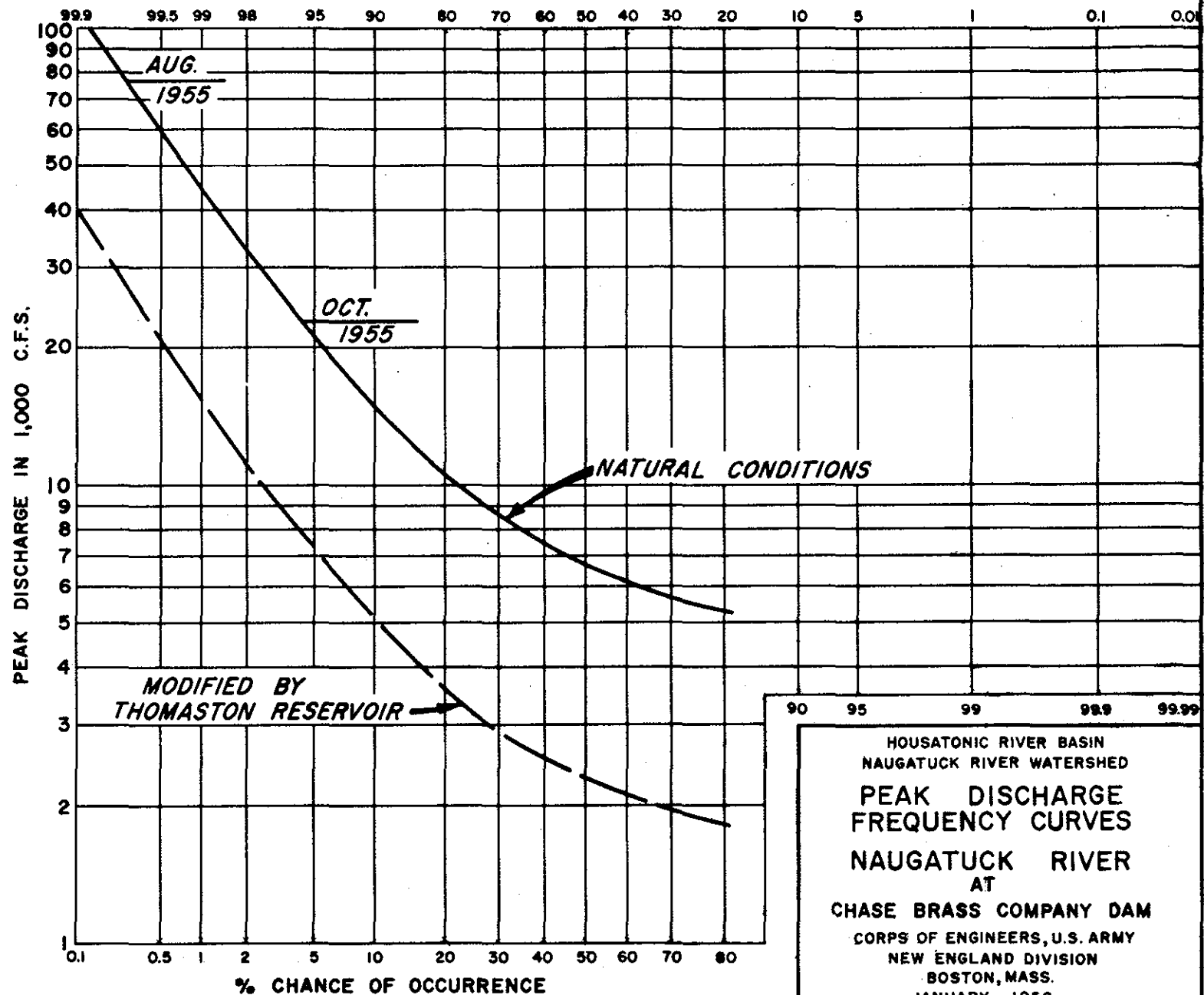
LEGEND
 U.S.G.S. GAGING STATIONS

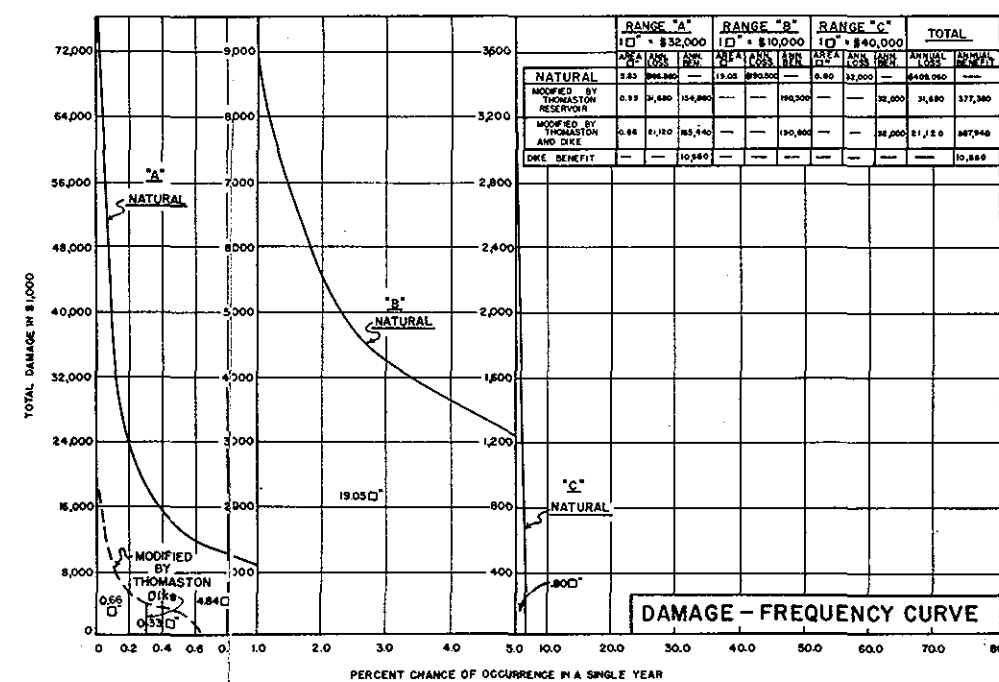
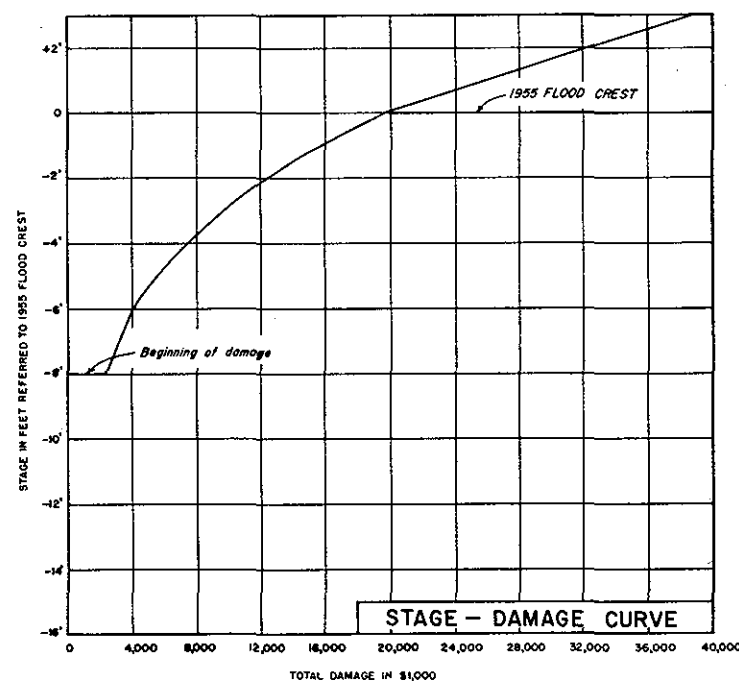
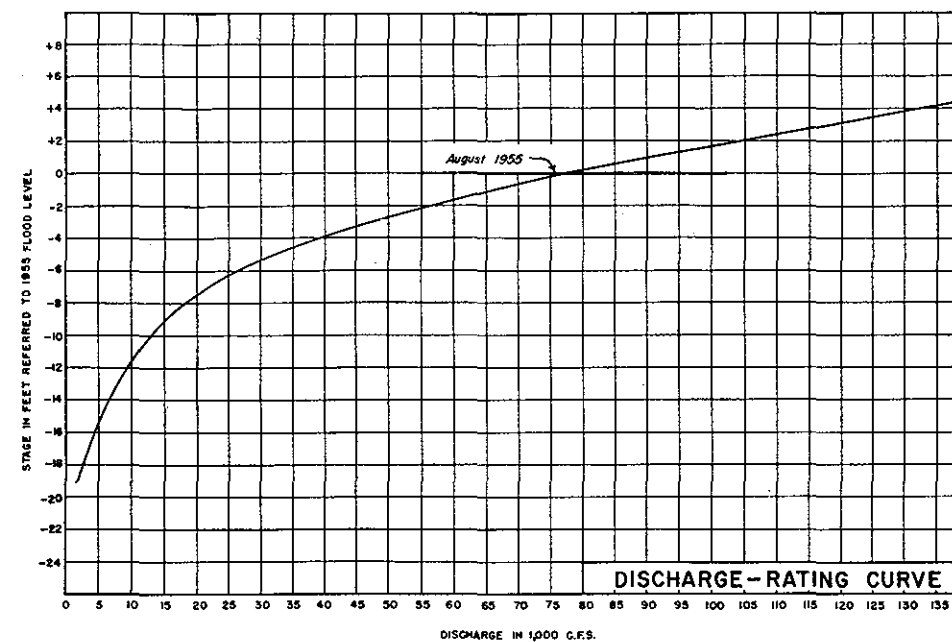
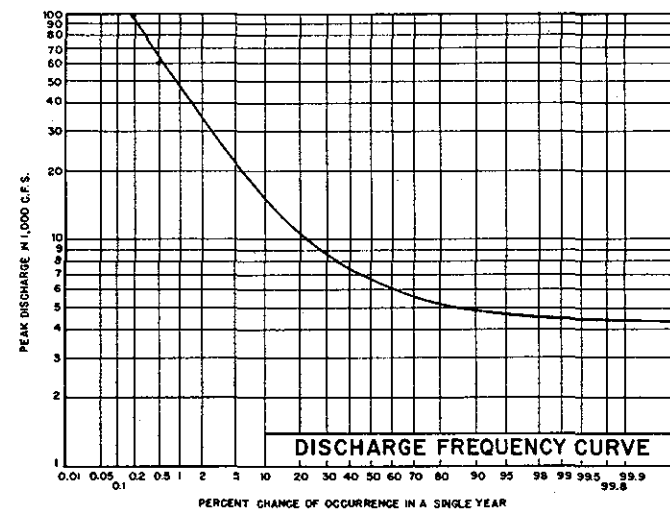
SCALE IN MILES
 0 1 2

REVISION	DATE	DESCRIPTION
CORPS OF ENGINEERS, U. S. ARMY OFFICE OF THE DIVISION ENGINEER NEW ENGLAND DIVISION BOSTON, MASS.		
NAUGATUCK RIVER FLOOD CONTROL		
NAUGATUCK RIVER WATERSHED		
DR BY S.F.C.	TR BY S.F.C.	CK BY A.R.O.
PROJECT ENGINEER SHELDON		DATE JAN. 1958
SUPERVISOR WATERBURY		SCALE: AS SHOWN
DRAWING NUMBER HC-1-1068		SHEET 1 OF 1

PLATE NO. 1







HOUSATONIC RIVER FLOOD CONTROL
WATERVILLE (WATERBURY) AND WATERTOWN, CONN.
LOCAL PROTECTION PROJECT
CURVES FOR ECONOMIC ANALYSIS
NEW ENGLAND DIVISION - BOSTON, MASS.
APRIL 1957